The two chapters which follow are devoted to a description of the different processes used in the detection and estimation of the various sugars in urine. There is much unnecessary detail regarding methods that are practically obsolete and the reader is not sufficiently informed as to which of those described the author, from personal experience, would recommend him to employ. The use of charcoal for the clarification of turbid urine (for polariscope examination) is condemned, because of adsorption of some of the sugar (p. 98), but no mention is made of the prevention of this adsorption when acetone or acetic acid is present in the solution. The method described for the estimation of the sugar in blood is obsolete.

In the chapter entitled "Experimental Glycosuria" a clear and well-arranged account of the results of some of the more recent laboratory investigations on this subject is given. The author, probably because he has not personally participated in such types of investigation, does not attempt to offer much criticism of the work; as a rule, he merely restates the views of others, thus leaving the reader to draw his own conclusions. In several parts of this chapter, however, the subject matter is not brought up to date as, for instance, in connection with the supposed antagonistic action of the pancreatic and adrenal glands in the control of the amount of sugar in the blood. The paragraphs on the relationship of the thyroid and parathyroid glands to carbohydrate metabolism and "on a theory of the co-relation of the ductless glands" are one-sided and highly speculative.

The remaining chapters are devoted to a study of the various degrees of transient and persistent glycosuria met with in man. This is distinctly the most important half of the book, for, while giving a well-arranged review of the work of other investigators, important personal experiences of the author himself are presented. Although it would be out of place for us to review at all extensively, this clinical portion of the book, there are yet one or two criticisms which may be appropriate. The account of the behavior of the creatin-creatinin excretion in diabetes is not brought up to date; there is practically no mention of the recent observations on the changes in the amount of the blood-sugar in diabetes; the so-called pancreatic reaction in the urine is not described in sufficient detail to make it possible for one unfamiliar with the author's previous writings to apply it properly, or even to understand upon what principles the reaction depends. The author lays great stress on the existence of pancreatic disease in most cases of diabetes, but beyond giving the case histories of a few diabetics in which pancreatic lesions may have existed, he adds no further evidence in support of such a conclusion.

The chapters on metabolism and treatment are distinctly successful and should be most useful to those called upon to treat this disease.

Taking the book as a whole it is not too much to say that it ranks with the best that have been written in this field. It is conservative and does not, as many of its forerunners do, extol any "specific" treatment which can be applied in all cases. On the contrary, it is frequently insisted upon that every case of diabetes must be considered as a problem in itself, and that the treatment must be adjusted so as to meet the peculiar conditions which it exhibits.

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SPECIAL ARTICLES

THE PREVALENCE OF BACILLUS RADICICOLA IN SOIL

THE fact that soils from fields where leguminous plants bear nodules upon their roots may be used as a means of introducing this type of nitrogen-fixing bacteria into barren soil shows clearly that the different varieties of *Bacillus radicicola,* the organism which causes the root nodules, find a congenial habitat in many kinds of soil. Aside from its manifestations in the symbiotic relationship with leguminous roots, however, practically nothing is known regarding the distribution

or function of *B. radicicola* as it occurs in nature. Within the past three years two authors, employing widely different methods, have attempted to supplement this rather meager information. With a rather comprehensive plan for tracing the functional activity presumably of nodule-forming bacteria from the soil, through pure culture conditions, and into root nodules again Gage[1] apparently confused himself with a variety of seemingly incompatible results, and by his unusual selection of descriptive terms heightened the indefinite character of his report; but even if his conclusions were absolutely correct no real advance has been made in our knowledge of the life history of *B. radicicola.*

A synthetic medium has been developed by Grieg-Smith,[2] who states that it is almost specifically selective for *Rhizobia.* It should be noted that *Rhizobia* is not defensible as a generic designation for *Bacillus radicicola.*[3] If the selective phenomenon of this culture medium were consistent for wide variations of soil flora and soil type, we should have in this medium a means for determining the approximate numbers of *B. radicicola* in any soil and their relation to other members of the microflora of the soil. The agar medium as described contains levulose, asparagine, sodium citrate, potassium citrate and tap water. At the time of using from 0.06 to 0.10 cubic centimeters of normal sodium carbonate is added to 10 cubic centimeters of the agar.

Plates of a medium prepared by these criteria were exposed to the air in the laboratory at Washington for 15 minutes. An average of four species of molds to the plate developed; also numerous species of bacteria, some of which were chromogenic. In order to compare the growth of molds in other media, there were exposed in various places in the laboratory petri plates containing beef agar, the nitrogen-free agar developed by us for isolating *B. radicicola,*[4] and Grieg-Smith's agar made with and without the addition of sodium carbonate. Table I. shows the results of these tests.

TABLE I

Number of Species of Molds Developing upon Various Media[5]

Beef Agar	Nitrogen-free Agar	Grieg-Smith Agar	Grieg-Smith Agar + Sodium Carbonate
1	3	5	4
3	2	2	2
—	1	3	2
2	3	4	4

Further tests were made by inoculating various cultures of bacteria into Grieg-Smith's agar, with the sodium carbonate added. Tubes of slanted agar were used and the organisms were streaked over the surface. The following organisms grew:

Sulphur yellow bacillus,
Bacillus coli,
Bacillus cloaca,
Micrococcus roseus,
Bacillus rossica,
Bacillus prodigiosus,
Staphylococcus aureus,
Bacillus mycoides,
Azotobacter beyerinckii (on petri dish),
Azotobacter chroococcum (on petri dish).

The following organisms did not grow:

Bacillus subtilis, black variety,
Bacillus radicicola isolated from vetch nodules,
Bacillus radicicola isolated from *Ceanothus* nodules,
Bacillus radicicola isolated from *Cycas* nodules,
Bacillus radicicola isolated from lima-bean nodules,
Bacillus radicicola isolated from alfalfa nodules.

[1] Gage, G. E., "Biological and Chemical Studies on Nitroso Bacteria," *Centralblatt für Bakteriologie, Parasitenkunde und Infektionskrankheiten,* 2. Abt., Bd. 27, No. 1/3, pp. 7–48, 1910.

[2] Grieg-Smith, R., "Determination of *Rhizobia* in the Soil," *Centralblatt für Bakteriologie, Parasitenkunde und Infektionskrankheiten,* 2. Abt., Bd. 34, No. 8/9, pp. 227–229, 1912.

[3] Kellerman, Karl F., "The Present Status of Soil Inoculation," *Centralblatt für Bakteriologie, Parasitenkunde und Infektionskrankheiten,* 2. Abt., Bd. 34, No. 1/4, pp. 42–50, 1912.

[4] Tap water, 1,000 c.c.; cane sugar, 10 grams; monobasic potassium phosphate, 1 gram; magnesium sulphate, 0.2 gram; shredded agar, 15 grams, with reaction adjusted to + 4 Fuller scale.

[5] Petri dishes opened for 15 minutes in the laboratory rooms at different times during the day. The figures are the averages of two plates for each exposure.

The growth of pure cultures of *B. radicicola* on this medium was further tested by the usual methods of poured plates in petri dishes. The relative suitability of the different media is shown in Tables II. and III.

TABLE II

Growth of B. radicicola in Grieg-Smith's Synthetic Media

Source	Strain	Media	
		Grieg-Smith's Agar	Grieg-Smith's Agar + Sodium Carbonate
Alfalfa.....	No. 101	+	+
Alfalfa.....	No. 134	—	—
Alfalfa.....	N. Y. soil[6]	+	+
Alfalfa.....	D. C. soil[7]	—	—
Cowpea.....	No. 103	+	+
Crimson clover...	No. 156	+	+

TABLE III

Comparative Suitability of Different Media for the Growth of B. radicicola

Source	Strain	Grieg-Smith Agar	Grieg-Smith Agar + Sodium Carbonate	Nitrogen-free Agar
Alfalfa....	No. 153	—	+	+
Alfalfa....	No. 134	—	+	+
Vetch.....	No. 151	—	—	+

Following the technique outlined by Grieg-Smith, direct isolation of *B. radicicola* was attempted from soil of three types: (1) soil used in potting plants at the Department of Agriculture greenhouses; (2) soil from Akron, Colo., taken from around the roots of *Astragalus falcatus* Lam., and known by check experiments to be able to inoculate the roots of *Astragalus sinicus* Linn.; and (3) soil from Ithaca, N. Y., which had been sterilized and inoculated with *B. radicicola* isolated from alfalfa nodules. The ordinary dilution technique was employed and dilutions of 1:100, 1:10,000 and 1:1,000,000 were taken. The agar was used with and without sodium carbonate, and the plates incubated five or six days at room temperature.

The greenhouse soil developed molds and various kinds of nonchromogenic bacteria on both media; on the media with sodium carbonate the Colorado soil developed molds and various kinds of nonchromogenic bacteria, while the media without the sodium carbonate gave an almost pure culture of one species; the New York soil gave pure plates with both agars. In observing these plates it was very noticeable that the agar with the sodium carbonate showed fewer colonies than the agar without it; this has been noticed in regard to both pure and mixed cultures.

The colonies selected for final test were those which resembled pure cultures of *B. radicicola*. The bacteria isolated from New York soil and from greenhouse soil were tested for their ability to infect alfalfa, and those from the Colorado soil were tested for their ability to infect *Astragalus sinicus*. These selections for tests were made because of previous empirical determinations of the inoculating power of these soils.

The tests were conducted in sand nearly devoid of nitrogen, moistened with Sach's solution from which the nitrogen compounds were lacking. Special glass jars designed to prevent contamination were employed for sheltering the plants which were grown from disinfected seeds. The plants grew well, considering the abnormal conditions to which they were subjected. At the expiration of 63 days the plants were taken from the jars and the roots carefully washed. Table IV. shows the inoculating power of the colonies selected from the petri plates of Grieg-Smith agar.

TABLE IV

Inoculating Power of Bacteria from Various Soils Isolated upon Grieg-Smith Agar

Plant	Source	Inoculation
Alfalfa.....	New York soil	+
Alfalfa.....	Greenhouse soil	—
Alfalfa.....	Uninoculated	—
Astragalus sinicus..	Colorado soil	—
Astragalus sinicus..	Uninoculated	Plants died.

[6] This test was made with New York soil furnished by Dr. B. M. Duggar, which he sterilized and then inoculated with a strain of bacteria isolated at Cornell University from alfalfa nodules.

[7] This test was made with District of Columbia soil which was sterilized and then inoculated with alfalfa bacteria, strain No. 134.

Since the New York soil contained only living organisms of *B. radicicola* known to be capable of inoculating alfalfa, the inoculation of alfalfa by the organism isolated from the New York soil was to be expected.

It seems fair to conclude that *B. radicicola* grows but sparingly and shows no especial characteristics upon synthetic agar made in accordance with the formula reported by Grieg-Smith, which seems to be no more selective than the synthetic agar we have employed for many years in the Washington laboratories, and is perhaps less selective than the congo-red agar described by one of us.[8] Further development of technique or of culture media will be required before we may hope to secure reliable data regarding the relative distribution and quantitative function of *B. radicicola* in the soil.

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SOME EFFECTS OF SUNLIGHT ON THE STARFISH

Starfish have been much studied for their reactions to light. Their general reactions and behavior have been well described by Preyer, von Uexkull, Jennings and others, and there is general agreement in the results recorded by these writers. Details of behavior of the different parts affected by light are for the most part meager or omitted.

The general reactions of *Asterias forbesii* are essentially like those described for other starfish and there is no reason to suppose that its reactions are essentially different in detail so far as it is possible to observe them. It has been previously shown by the writer[1] that certain parts of the animal are sensitive to light. It has further been found that there is a definite time reaction between the moment when the light strikes the sensitive parts and the moment when they show a definite visible response, and the general reaction which follows, provided the light has sufficient intensity.

Individuals without the pigment or "eye" spots react as definitely to light as do those with the pigment spots intact. This was also found to be true for *Echinaster* (Cowles). The upper surface, the sides of the rays, the ventral surface and the tube feet are sensitive to light, since they show a direct response to it. The dermal branchia also show response to light stimuli. The behavior of dermal branchia is of peculiar interest, since their retraction must influence the extent of the aerating surface of the animal. The sudden illumination of a ray or a spot on it causes a retraction of the parts illuminated. If the area is large there is a bending of the ray ventralward no matter what the direction of the source of light. Following this primary reflex, there arise movements which lead eventually to the general response or behavior. Three stages are recognizable. These are: the initial or direct effect of light; the local direct response of the parts affected, and lastly the general effect and reactions in response to the influence of the preceding changes. It is apparently through these interactions that the external stimulus is finally transformed into reaction and behavior through the vortex of metabolic changes in protoplasm.

Loeb has maintained that "reactions are caused by a chemical effect of light" and that "the velocity or the character of the chemical reactions in the photosensitive elements of both sides of the body is different," and hence "the muscles or the contractile elements on one side of the organism are in a higher state of tension than their antagonists." One wishes for more direct evidence and, if such is possible, direct proof that light does influence the chemical processes of normal metabolism, than the above assumptions afford. While it is generally assumed that light does cause chemical changes in organisms and these must influence the reactions of the organisms, there is a significant absence of direct experimental proof.

[8] Kellerman, Karl F., "The Relation of Crown-gall to Legume Inoculation," U. S. Department of Agriculture, Bureau of Plant Industry, Circular 76, p. 4, 1911.

[1] Science, N. S., Vol. 35, p. 119.